

**Materials
Science**

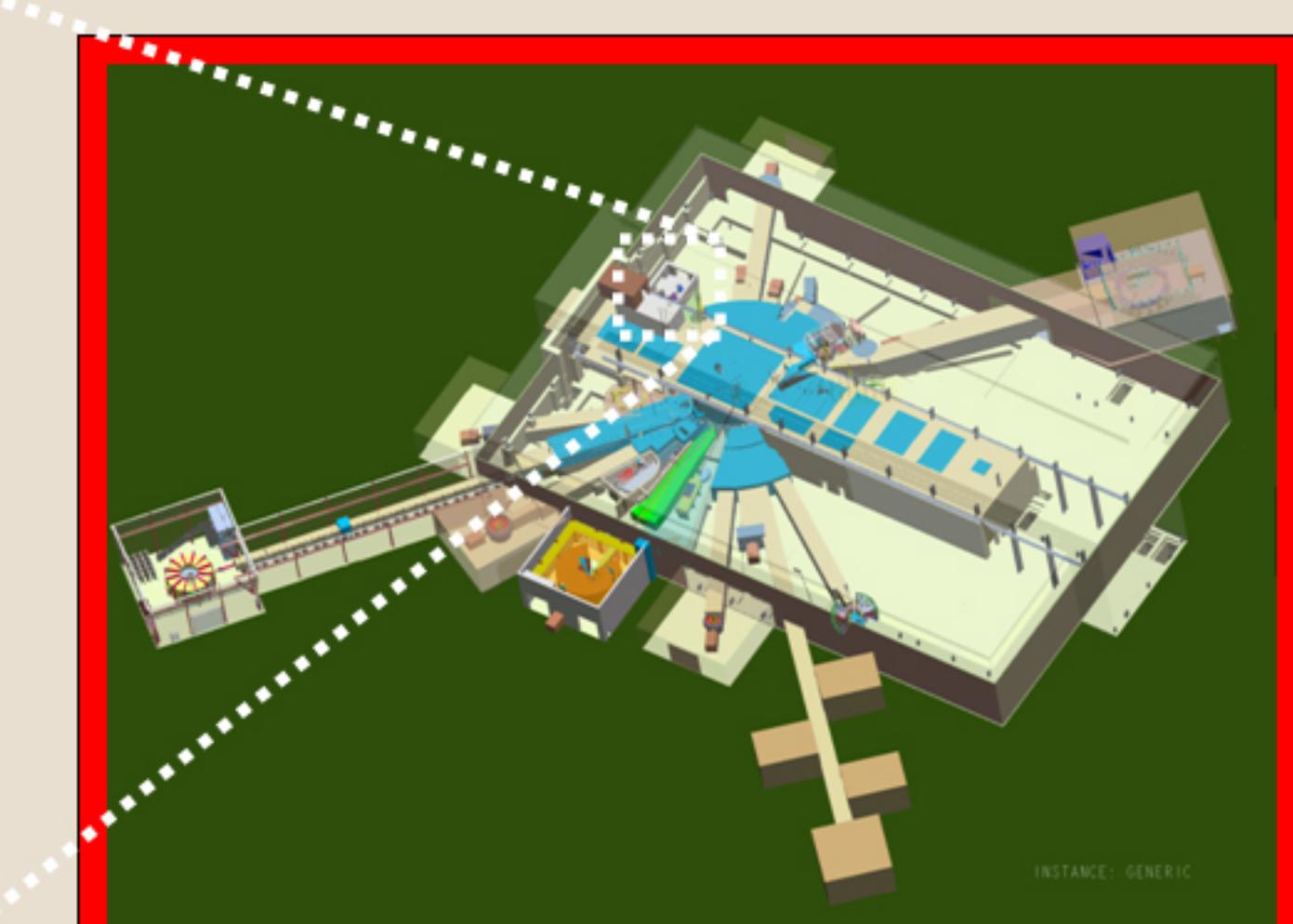
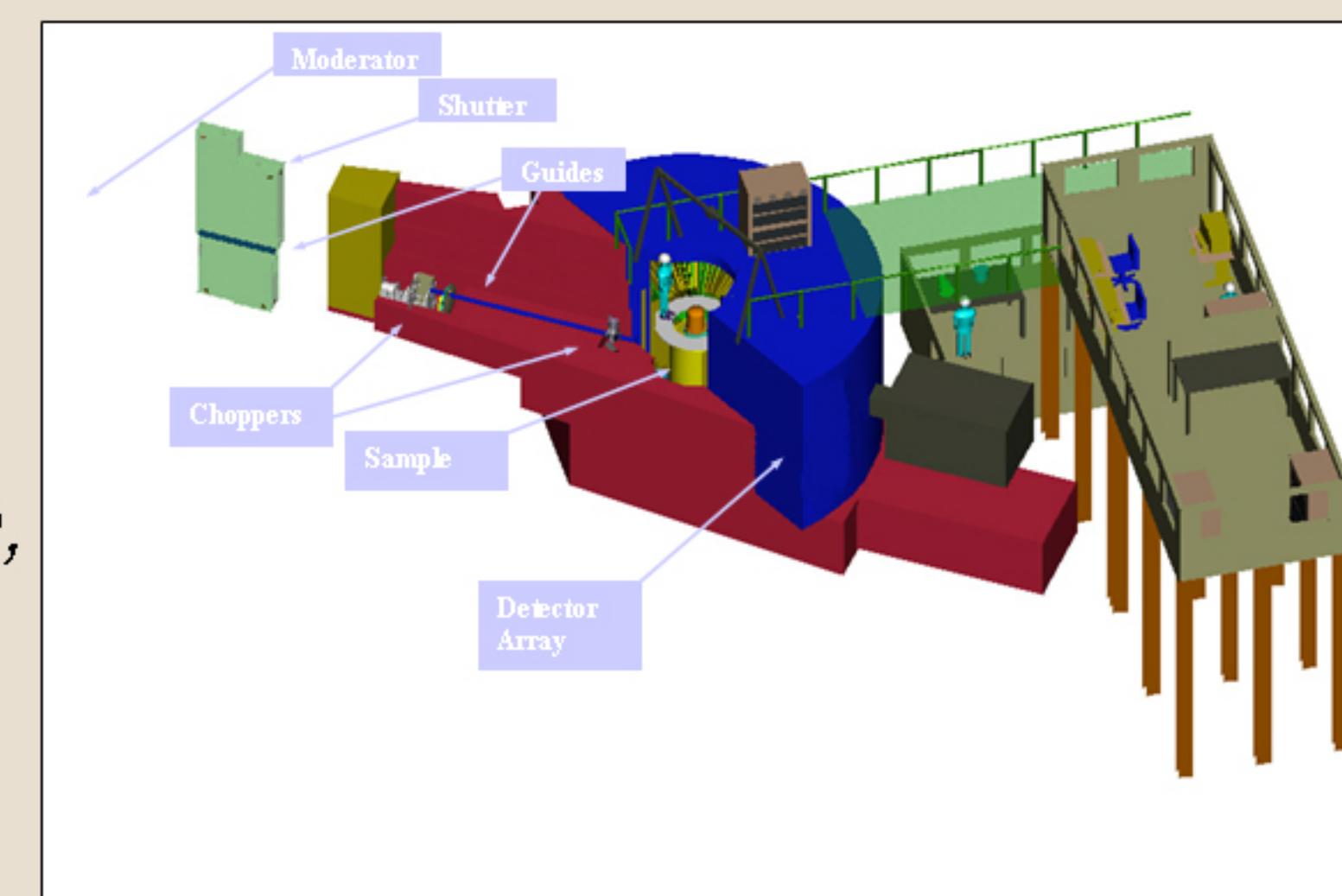
A wide Angular Range Chopper Spectrometer at the SNS



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The Department of Energy has funded the construction of a wide Angular Range Chopper Spectrometer (ARCS) at the Spallation Neutron Source.

ARCS will be optimized to provide a high neutron flux at the sample, and a large solid angle of detector coverage. It is designed to measure excitations in materials and condensed matter having energies from a few to several hundred meV.

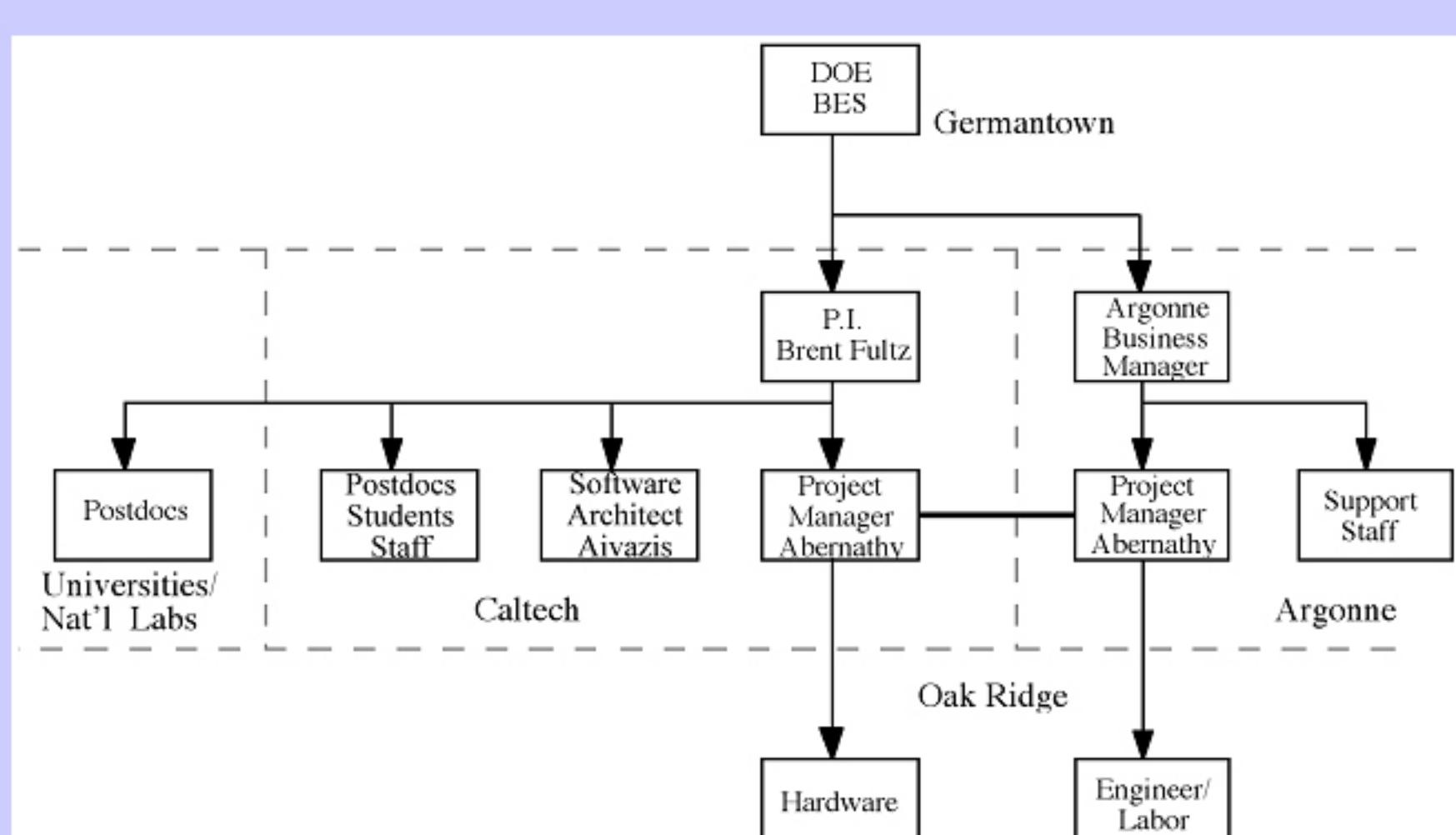


Typical research topics include: (i) studies of vibrational excitations and their relationship to phase diagrams and equations of state of materials, including materials with correlated electrons, and (ii) studies of spin correlations in magnets, superconductors, and materials close to metal-insulator transitions.

More about the instrument is available at the web site: <http://arcs.caltech.edu/arcs/ARCS.html>.

Instrument Development Team

Principal Investigator: Brent Fultz, Caltech
Instrument Scientist: Doug Abernathy, ORNL
Instrument Engineer: Robb Williams, ANL
Software Engineer: Michael Aivazis, Caltech
Executive Committee: Fultz, Abernathy, Beyerman, McQueeney, Nagler, Osborn

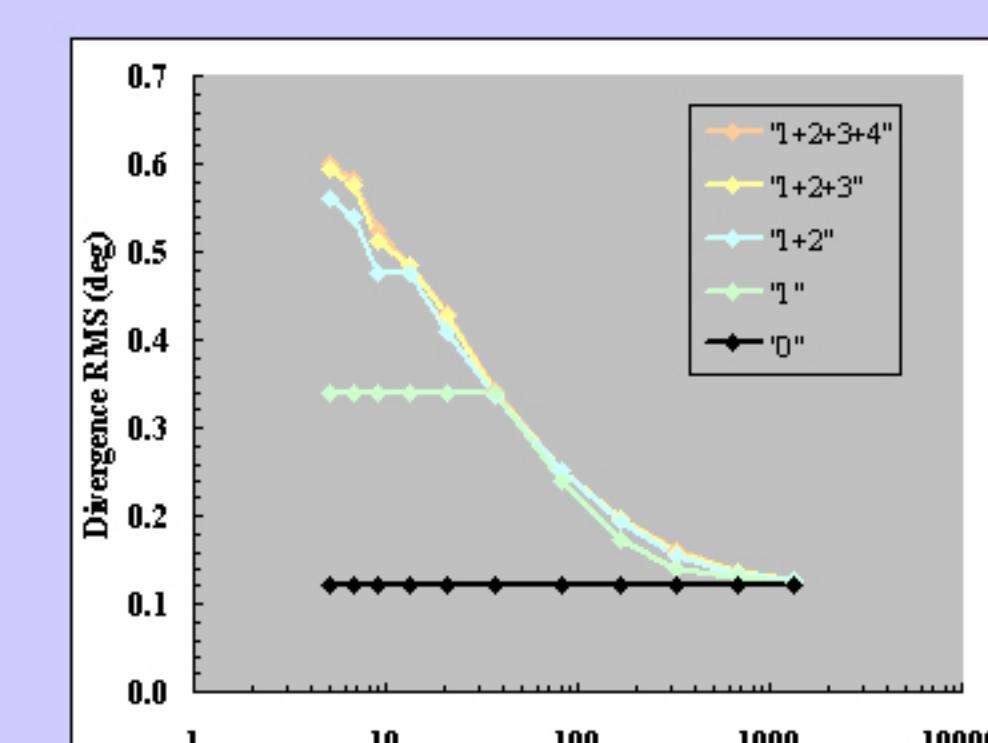
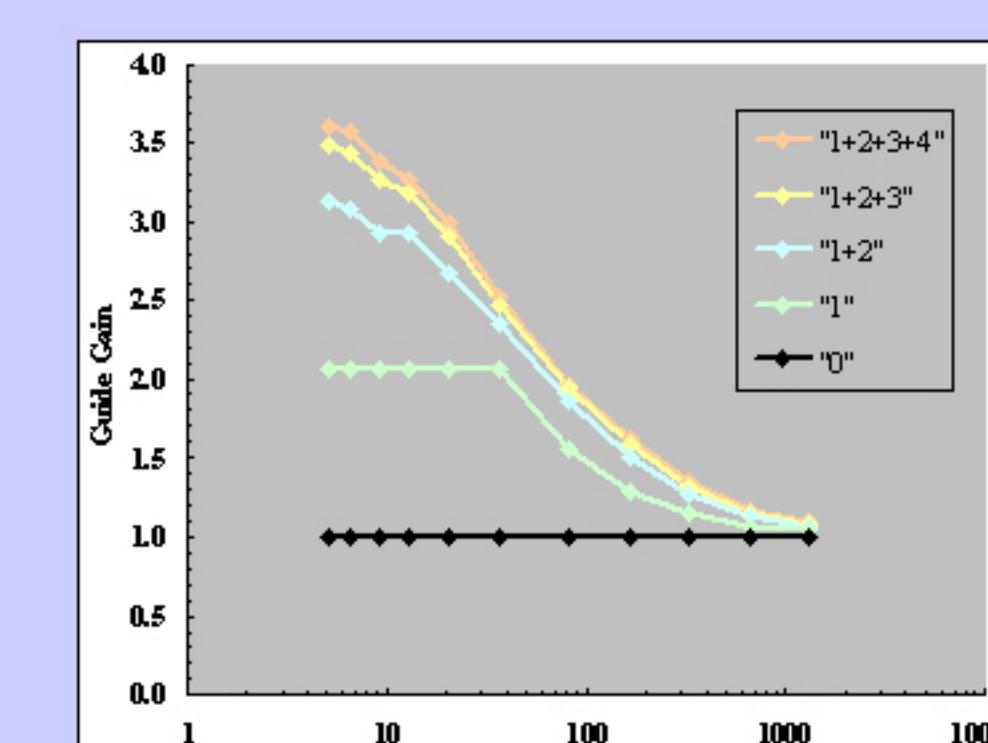
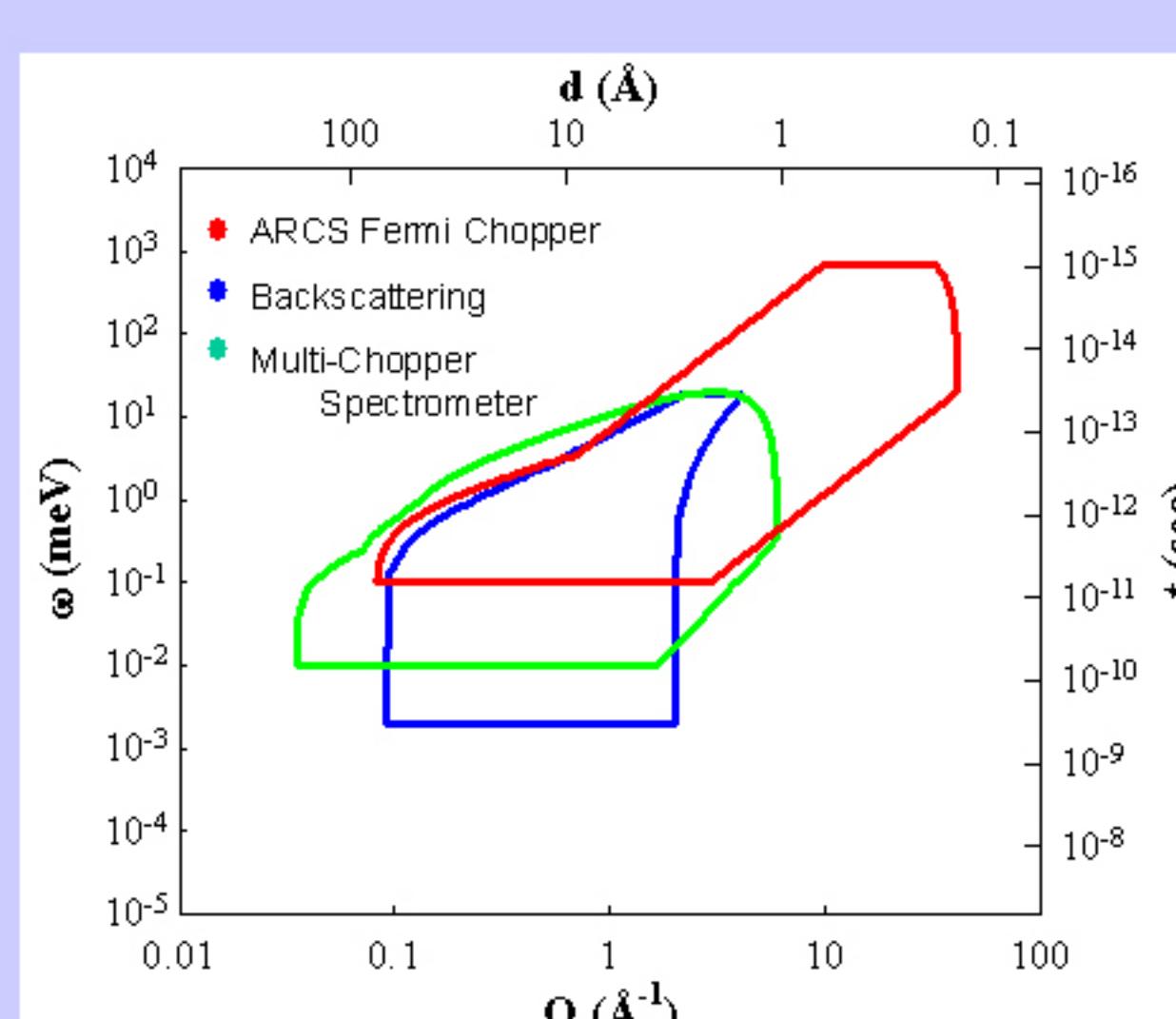
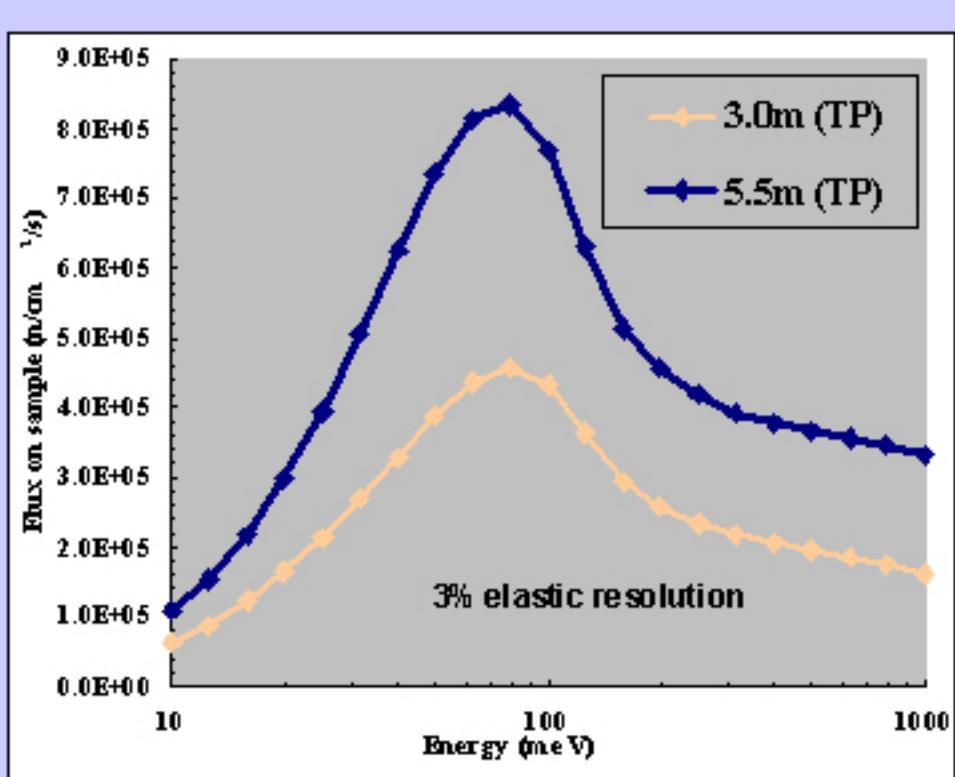
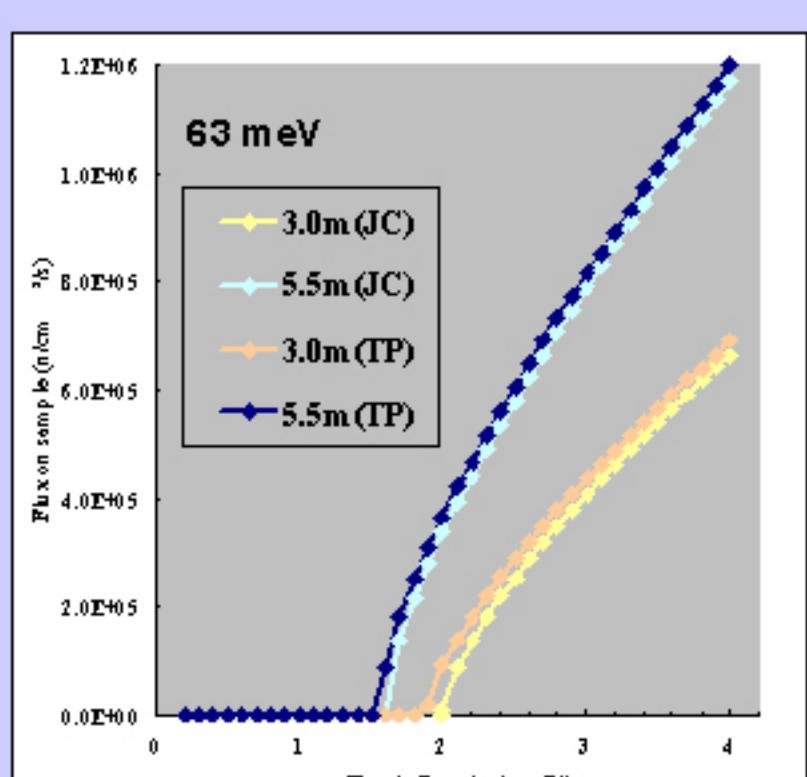


Instrument Parameters

| Spectrometer | ARCS | High Resolution |
|-----------------------------------|--|--|
| Moderator and dimensions | Ambient H ₂ O decoupled poisoned 18EU 100mm(H) x 120mm(V) | |
| Angle | 13.75° (possible 27.5°) | 0° (possible 13.75°) |
| Geometry | | |
| Source-chopper (L ₁) | 11.6m | 15.5m |
| Chopper-sample (L ₂) | 2.0m | 2m |
| Sample-detector (L ₃) | 3.0m | 6m |
| Choppers | | |
| T0 horizontal axis | Mechanical 60 Hz @ 9.0m | Mechanical 60 Hz @ 10.0m |
| Disk | Mechanical 60 Hz @ 9.5m | Mechanical 60 Hz @ 10.5m |
| E0 (Fermi) vertical axis | Magnetic 600 Hz @ 12.0m | Magnetic 600 Hz @ 15.5m |
| Guide | | |
| Type | Tapered supermirror 3.6 θ _e | Tapered supermirror 3.6 θ _e |
| Length | ~8.1 m | ~11m |
| Apertures and collimators | | |
| After E0 (Fermi) chopper | 2-4 Variable | 2-4 Variable |
| After E0 (Fermi) chopper | Soller collimator | Soller collimator |
| Max. sample size | 50mm(H) x 50mm(V) | 50mm(H) x 50mm(V) |

| Spectrometer | ARCS | High Resolution |
|-------------------------------|---------------------------------------|---|
| Scattering/sample chamber | | |
| Radius sample-detector | 3m | 6m |
| Height | 3m | 6m |
| Vacuum at sample | < 10 ⁻⁴ torr | < 10 ⁻⁴ torr |
| Vacuum flightpath | < 10 ⁻⁴ torr | < 10 ⁻⁴ torr |
| Collimation | | |
| Oscillating radial collimator | | |
| Shielding outer | B,C, 100m ² | B,C, 200m ² |
| Shielding inner | ~0.5 m (TBD) thick, 200m ² | ~0.5 m (TBD) thick, 400m ² |
| Linear PSDs | | |
| Number | 900 | 1200 |
| Type | ³ He 10 atm | ³ He 10 atm |
| Diameter | 25mm | 25mm |
| Length | 965mm (active) | 965mm (active) |
| Resolution | 25mm | 25mm |
| Total pixels | 35,000 | 50,400 |
| Angular range, horizontal | -30° to -3°, 3°-150° | -30° to -2°, 2°-30° (low), 30°-60° (high) |
| Vertical, low bank | ± 30° | ± 30° |
| Vertical, high bank | | |
| Low bank solid angle/area | 2.95 sr / 26.7 m ² | 0.70 sr / 26 m ² |
| High bank solid angle/area | | 0.12 sr / 4 m ² |
| Total area | 26.7 m ² | 30 m ² |

Performance



Guide gain and divergence (typical; one dimension)

Current activities and issues

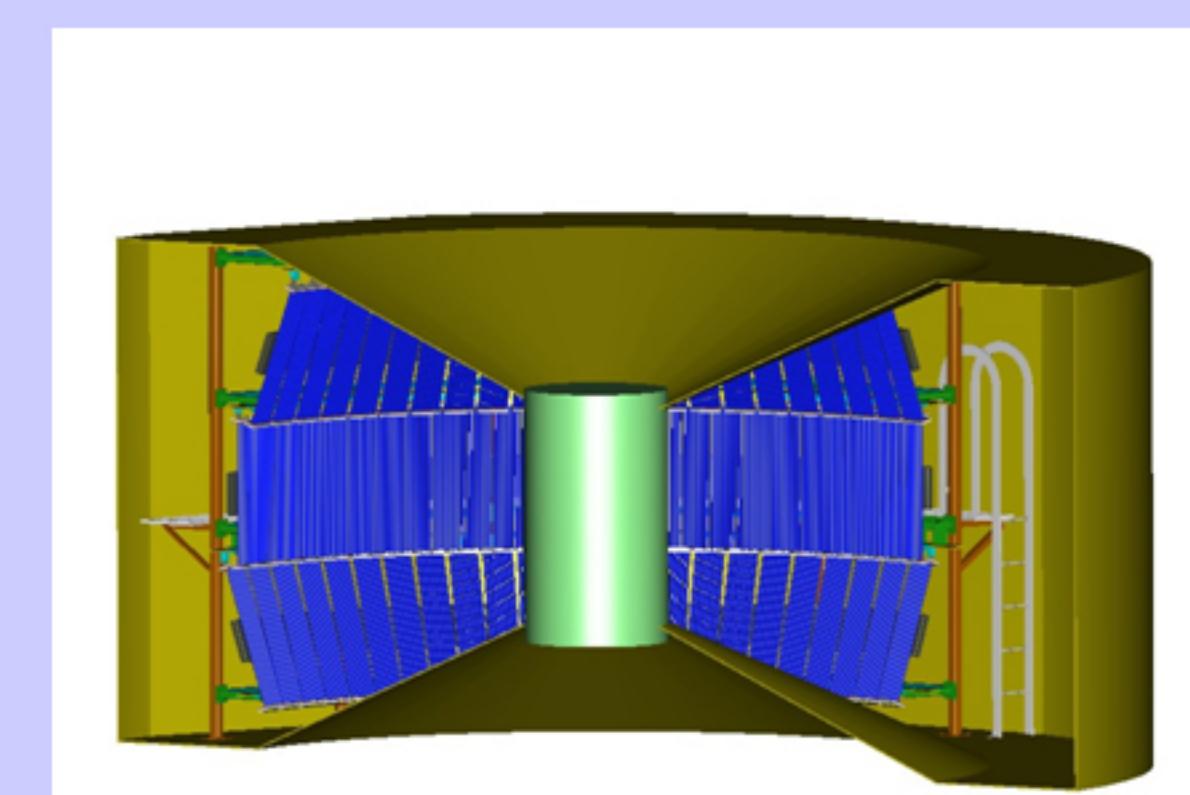
Hardware:

Shielding Calculations are underway to see effects of proton-transport line and adjacent beamline.

Vacuum vessel and detector design Detectors will be tested in vacuum along with mounting mechanisms.

Guide design Determine how best to reduce background while maximizing gain and divergence control.

Sample manipulation and access What motions of the sample are needed on the spectrometer?



Software:

Status Evaluate current data analysis and simulation packages.

New simulations Combine Monte Carlo with novel models of sample scattering.

Scripting Combine software with a scripting language for modern, flexible and maintainable package.